

Attorney Docket No. 06666-076001
Application No. 09/848,773
Amendment dated March 24, 2004
Reply to Office Action dated November 26, 2003

Amendment to the Claims:

This listing of claims replaces all prior versions, and listings, of claims in the application:

1. (Original) A method, comprising:

obtaining two images of similar image information from two uncalibrated sources;

superimposing lines formed on said images to rectify the two images relative to one another to form rectified images; and

using said rectified images to form three-dimensional information by forming a disparity map of three dimensional information for specified coordinates of matching pixels.

2. (Original) A method as in claim 1, wherein said using comprises forming a disparity map indicating an estimate of the three dimensional surface, and information about likelihood of said estimate.

3. (Original) A method as in claim 1, further comprising initially manually establishing matching parts, and wherein said using comprises automatically using said rectified images to form said three-dimensional information.

Attorney Docket No. 06666-076001
Application No. 09/848,773
Amendment dated March 24, 2004
Reply to Office Action dated November 26, 2003

4. (Original) A method as in claim 3 wherein said manually obtaining comprises identifying identifiable parts in the image.

5. (Original) A method as in claim 1 wherein said superimposing comprises defining said images in terms of epipolar geometry, and aligning said images in said epipolar geometry.

6. (Original) A method as in claim 2, wherein said rectification transformation in said epipolar geometry is one which aligns specified reference lines in the image.

7. (Original) A method as in claim 6, wherein said reference lines include lines passing through manually-obtained image parts.

8. (Original) A method as in claim 7, wherein said transformation aligns said specified reference lines by finding an average of end points of two different reference lines, and forming a line through an averaged part.

Attorney Docket No. 06666-076001
Application No. 09/848,773
Amendment dated March 24, 2004
Reply to Office Action dated November 26, 2003

9. (Original) A method as in claim 1, wherein said using comprises forming a disparity surface indicative of three-dimensional information of the image.

10. (Original) A method as in claim 9, wherein said disparity surface includes information indicative of a difference between coordinates of matching pixels.

11. (Original) A method as in claim 9, further comprising forming a variable denoting a degree of similarity between pixels.

12. (Original) A method as in claim 1, wherein said using comprises forming a three-dimensional surface indicative of three-dimensional information contained in said two images, and forming a variable which indicates a likelihood of error in said three-dimensional surface.

13. (Original) A method as in claim 12, wherein said forming a variable comprises forming a plurality of seed voxels, and tracing a surface of said plurality of seed voxels.

Attorney Docket No. 06666-076001
Application No. 09/848,773
Amendment dated March 24, 2004
Reply to Office Action dated November 26, 2003

14. (Original) A method as in claim 13, wherein said tracing is carried out for a plurality of said voxels in a multiresolution fashion, such that certain voxels are computed at a coarsest level, and other voxels are computed at a more detailed level.

15. (Original) A method as in claim 13, wherein said tracing comprises calculating an entire volume at the coarsest level, and calculating some amount less than the entire volume at a subsequent level.

Cont
16. (Original) A method as in claim 13, further comprising selecting a seed voxel by finding uniqueness.

17. (Original) A method as in claim 13, further comprising selecting the seed voxel using a winner take all technique which has a maximum correlation value.

18. (Original) A method as in claim 17, further comprising identifying seed voxels which represent incorrect matches, and removing said seeds after said tracing.

Attorney Docket No. 06666-076001
Application No. 09/848,773
Amendment dated March 24, 2004
Reply to Office Action dated November 26, 2003

19. (Original) A method as in claim 12, wherein said using comprises converting said volume to a plurality of Euclidean points.

20. (Original) A method as in claim 19, wherein said converting comprises projecting a reconstruction of said volume, and then reconstructing Euclidean points from said projective reconstruction.

21. (Original) A method as in claim 19, wherein said converting comprises transforming an origin of a coordinate system to an origin of one of said images.

22. (Original) A method as in claim 20, wherein said reconstructing comprises allowing a user to input a parameter, and adjust the parameter to approximate a proper Euclidean reconstruction.

23. (Original) A method as in claim 22 wherein said parameter is focal length.

Attorney Docket No. 06666-076001
Application No. 09/848,773
Amendment dated March 24, 2004
Reply to Office Action dated November 26, 2003

24. (Original) A method as in claim 13, further comprising dividing said surface into a plurality of parts, and said seed voxels are respectively for said plurality of parts.

25-28. (Canceled)

29. (Previously Presented) A method comprising:
obtaining first and second images of the same object;
identifying objects in said first and second images, and
forming lines which intersect said objects;
aligning said lines in an epipolar geometry representation;
using said first and second images, with said aligned lines, to form three-dimensional information; and
identifying at least one seed voxel, with a relatively high probability of being a correct three-dimensional measure.

30. (Original) A method as in claim 29, further comprising forming at least a part of said surface map by propagating from said seed voxel.

31. (Currently amended) A method as in claim 29, wherein said identifying at least one seed ~~voxel~~ voxel comprises selecting a seed ~~voxel~~ voxel that has three-dimensional

Attorney Docket No. 06666-076001
Application No. 09/848,773
Amendment dated March 24, 2004
Reply to Office Action dated November 26, 2003

information for corresponding pixel information u,v that is unique and has a probability of being correct which is greater than a specified threshold.

32. (Currently amended) A method as in claim 29, further comprising identifying a plurality of seed ~~Voxels~~ voxels for each of a plurality of different parts of the three-dimensional surface information.

C Cont
33. (Original) A method as in claim 31, wherein said specified threshold is greater than 0.99.

34. (Currently amended) A method as in claim 32, further comprising determining intersections between ~~Voxels~~ voxels at said different parts, and determining which of two ~~Voxels~~ voxels to use at said intersections.

35. (Currently amended) A method as in claim 34, wherein said determining which ~~Voxels~~ voxels to use comprises determining a probability of each of the two ~~Voxels~~ voxels, and selecting the higher probability as the ~~Voxel~~ voxel to use.

Attorney Docket No. 06666-076001
Application No. 09/848,773
Amendment dated March 24, 2004
Reply to Office Action dated November 26, 2003

36. (Currently amended) A method as in claim 32, wherein said propagating comprises finding neighbors for ~~Voxels~~ voxels, one by one.

37. (Currently amended) A method as in claim 29, wherein said identifying at least one seed ~~Voxel~~ voxel comprises selecting a seed voxel that has three-dimensional information for corresponding pixel information that the best matches the corresponding pixel information, and has a probability of being correct which is greater than a specified threshold.

38. (Original) A method as in claim 37, further comprising identifying voxels which represent incorrect matches, and removing said voxels which represent incorrect matches.

39. (Previously presented) A method comprising:
obtaining first and second images of the same object;
identifying objects in said first and second images, and forming lines which intersect said objects; and
aligning said lines in an epipolar geometry representation further comprising using said first and second images, with said aligned lines, to form three-dimensional information; and

Attorney Docket No. 06666-076001
Application No. 09/048,773
Amendment dated March 24, 2004
Reply to Office Action dated November 26, 2003

wherein said three-dimensional information includes a disparity map, and further comprising converting said disparity map into three-dimensional Euclidean points.

40-42. (Canceled)

43. (Currently amended) A method, comprising:

obtaining information about an image from two uncalibrated cameras;

using said information from said two uncalibrated cameras to obtain three-dimensional information;

wherein said using comprises rectifying said images ~~to~~ to form coplanar images with scan lines that are horizontally parallel; and

wherein said rectifying comprises identifying points in each of the images, and identifying scan lines which pass through said points.

Attorney Docket No. 06666-076001
Application No. 09/848,773
Amendment dated March 24, 2004
Reply to Office Action dated November 26, 2003

44. (Currently amended) A method, comprising:
obtaining information about an image from two uncalibrated
cameras;
using said information from said two uncalibrated cameras
to obtain three-dimensional information;
wherein said using comprises rectifying said images ~~is~~ to
form coplanar images with scan lines that are horizontally
parallel; and
further comprising finding an average of said scan lines
between one end of a first image and another end of a second
image, and reforming said scan lines between said one end and
another end to form said horizontally parallel scan lines.

Cal Cont

45. (Original) A method as in claim 44, further comprising
using said information to form a disparity surface which
represents three-dimensional information corresponding to each
of said two-dimensional points.

46. (Currently amended) A method, comprising:
obtaining information about an image from two uncalibrated
cameras;
using said information from said two uncalibrated cameras
to obtain three-dimensional information;

Attorney Docket No. 06666-076001
Application No. 09/848,773
Amendment dated March 24, 2004
Reply to Office Action dated November 26, 2003

wherein said using comprises rectifying said images ~~is~~ to form coplanar images with scan lines that are horizontally parallel; and

further comprising using information from said rectified images to form third dimension information associated with each of said two-dimensional points of said image.

47. (Original) A method as in claim 46, wherein said third dimensional information includes a probability that the third dimensional information is correct.

Cont
48. (Original) A method as in claim 46, further comprising dividing the image into a plurality of patches, and finding said third dimensional information for each of said plurality of patches.

49. (Original) A method as in claim 48, further comprising determining third dimensional information for pixels on edges of said patches.

50. (Currently amended) A method, comprising:
obtaining two images of similar image information from sources;

Attorney Docket No. 06666-076001
Application No. 09/848,773
Amendment dated March 24, 2004
Reply to Office Action dated November 26, 2003

superimposing lines formed on said ~~to~~ two images to rectify the two images relative to one another to form rectified images; and

using said rectified images to form three-dimensional information.

51. (Original) A method as in claim 50, wherein said superimposing comprises:

identifying specified points in the images which pass through specified identifiable parts in each of the images; forming lines through said specified points; and aligning said lines between the different images by aligning beginnings and ends of said lines.

52. (Original) A method as in claim 51, wherein said lines are aligned by using an epipolar transformation.

53. (Original) A method as in claim 52, wherein said epipolar transformation is carried using information in the fundamental matrix.

54. (Original) A method as in claim 50, wherein said two images are recovered from two uncalibrated cameras.

Attorney Docket No. 06666-076001
Application No. 09/848,773
Amendment dated March 24, 2004
Reply to Office Action dated November 26, 2003

55. (Original) A method, comprising:
obtaining two images of similar image content;
forming a disparity map of three dimensional information
for specified coordinates of matching pixels by forming a
plurality of areas, finding seed voxels in each of said
plurality of areas which have relatively high probability of
being correct matches and propagating to other pixels from said
seed voxels.

Cont
56. (Original) A method as in claim 55, wherein said
propagating comprises forming a surface in a volume as said
disparity surface.

57. (Original) A method as in claim 55, wherein said
finding seed voxels comprises reviewing each said section, and
finding a voxel with a peak correlation value in each said
section as said seed voxel.

58. (Original) A method as in claim 55, wherein said
finding seed voxels comprises reviewing each said section, and
finding a first found voxel with a correlation value greater

Attorney Docket No. 06666-076001
Application No. 09/048,773
Amendment dated March 24, 2004
Reply to Office Action dated November 26, 2003

than a specified threshold in each said section as said seed voxel.

59. (Original) A method as in claim 55, further comprising calculating first information at a first resolution for said seed voxels, and calculating second information, at a second resolution less than said first resolution, for other voxels other than said seed voxels.

60. (Original) A method, comprising:
obtaining two images of similar image content;
forming a disparity map of three dimensional information for specified coordinates of matching pixels by forming a plurality of areas, finding first information in each of said plurality of areas which have relatively high probability of being correct matches and obtaining said first information at a first resolution, and propagating along a surface to obtain second information at a second resolution less than said first resolution.

61. (Original) A method as in claim 60, wherein said two images are from two separate image sources.

Attorney Docket No. 06666-076001
Application No. 09/848,773
Amendment dated March 24, 2004
Reply to Office Action dated November 26, 2003

62. (Original) A method as in claim 60, wherein said first information is seed information.

*C1
concl.* 63. (Original) A method as in claim 60, wherein said seed information is obtained by a winner-take-all test, where, at each pixel (u,v) , all voxels (u,v,d) where $d \in [-W_0/2, W_0/2]$ are computed, and a voxel with a maximum correlation value is used.
